Credit value: 10

# 2 Communications for Engineering Technicians

**Engineering involves a wide range of activities, so it is important that there is effective communication between the people doing them. This may take a variety of forms, but it must always be done in a way which ensures that data is accurately conveyed. In engineering there is no place for ambiguity because mistakes cost money, and this ultimately affects the profitability of a business.**

If a designer prepares a component drawing which has errors or which incorrectly specifies the material to be used, then the product will be manufactured incorrectly. Time and money will have to be spent rectifying the problem. To prevent this happening again, designers need to know that they have made a mistake. Suppose you are an apprentice engineer responsible for machining the component. You would have to tell the designer that there is a problem. What information will you need and what's the best way to present it?

In this unit you will explore the principles and use of visual communication methods, technical report writing and verbal presentation. You will also investigate how information communication technology (ICT) operates in engineering settings.

## Learning outcomes

After completing this unit you should:

1. be able to interpret and use engineering sketches/circuit/network diagrams to communicate technical information
2. be able to use verbal and written communication skills in engineering settings
3. be able to obtain and use engineering information
4. be able to use information and communication technology (ICT) to present information in engineering settings.

# Assessment and grading criteria

**This table shows you what you must to in order to achieve a pass, merit or distinction grade, and where you can find activities in this book to help you produce the required evidence.**

| To achieve a **pass** grade the evidence must show that you are able to: | To achieve a **merit** grade the evidence must show that, in addition to the pass criteria, you are able to: | To achieve a **distinction** grade the evidence must show that, in addition to the pass and merit criteria, you are able to: |
|---|---|---|
| **P1** interpret an engineering drawing/ circuit/network diagram **Assessment activity 1 page xx** | **M1** evaluate a written communication method and identify ways in which it could be improved **Assessment activity 3 page xx** | **D1** justify your choice of a specific communication method and the reasons for not using a possible alternative **Assessment activity 3 page xx** |
| **P2** produce an engineering sketch/ circuit/network diagram [CT1] **Assessment activity 2 page xx** | **M2** review the information sources obtained to solve an engineering task and explain why some sources have been used but others rejected **Assessment activity 4 page xx** | **D2** evaluate the use of an ICT presentation method and identify an alternative approach **Assessment activity 5 page xx** |
| **P3** use appropriate standards, symbols and conventions in an engineering sketch/circuit/network diagram **Assessment activity 2 page xx** | **M3** evaluate the effectiveness of an ICT software package and its tools for the preparation and presentation of information **Assessment activity 5 page xx** | |
| **P4** communicate information effectively in written work **Assessment activity 3 page xx** | | |
| **P5** communicate information effectively using verbal methods **Assessment activity 3 page xx** | | |
| **P6** use appropriate information sources to solve an engineering task [IE4] **Assessment activity 4 page xx** | | |
| **P7** use appropriate ICT software packages and hardware devices to present information **Assessment activity 5 page xx** | | |

# How you will be assessed

This unit will be assessed through assignments designed and marked by the staff at your centre.

The type of evidence you will need to present when you carry out an assignment could be in the form of:

- a portfolio of sketches, or circuit or network diagrams supported by a written commentary
- a portfolio which shows of your skills in note taking, writing and keeping a logbook
- a tutor observation record or video clip of you speaking, listening and using body language to communicate effectively
- a printout of a PowerPoint presentation.

## Emma, 18, apprentice electronic technician

I started my apprenticeship straight from school and am now in the second year. At the moment I am working in the product quality assurance (QA) department, where I help with testing amplifiers and power supplies.

During testing we record data such as power consumption, voltages and temperatures, and this numerical data is entered into an ICT system. I also have to write evaluation reports, which are presented to the product designers.

I studied this communications unit last year. It has really helped me in my present job and it has made me more confident, particularly when I have to talk to other technicians and designers about our products.

One day I discovered what I thought to be a significant design problem with a power supply – it kept overheating and tripping out. On further investigation I identified that an incorrect component had been fitted, and it was down to me to tell someone in the manufacturing department that a batch of 100 units had not been assembled to specification. A year ago I would have been very nervous about doing this, as I was always the quiet one at school.

I do like working in QA because it links with design, manufacture and product development. I can now see how all the topics I studied in this unit fit together and really help me with my job.

# 2.1 Be able to interpret and use engineering sketches/circuit/network diagrams to communicate technical information

**Start up**

### Speaking, listening, interpreting and writing

Get together with three other people from your group and find somewhere quiet to sit. Make sure that each member of the group has a pen and paper to take notes.

Each member of the group should then introduce themselves, talking for a couple of minutes about an interesting activity that they have carried out during the previous week. This could be something at work, a hobby or sport, or it could be about a radio or television programme – anything that will gain the attention of the other members of the group.

The rest of the group should make notes. Then, working individually and using a word-processing package, write a **profile** about each of the other members of the group based on their talks. Each profile should be about 150 words long.

Now regroup, and give the profiles to the relevant person and see if they agree with what you and the rest of the group have written about them.

Your profiles may be completely accurate: why is this?

There may be errors in your profiles: why is this?

Engineers use many different graphical techniques to communicate ideas and information. These include sketches, assembly drawings, **3D** exploded diagrams, electrical circuit diagrams, plant layout diagrams and operating procedures presented as flow charts.

When using graphical techniques it is important to follow accepted codes of practice so that there is no ambiguity about the message being conveyed. Machining metal, installing a fluid power system or assembling components are expensive activities, and it is important that the requirements of the designer are conveyed accurately to people working on the shop floor or at a customer's premises.

Looking at and understanding graphics is a common aspect of everyday life. For example, most people understand the signs used in public places to indicate fire exits or no smoking. It only requires common sense to understand what the graphics mean. Other graphics are more specialised and may be difficult for people to understand unless they have **expert knowledge**.


You should be able to understand graphics even if some of them include words in a foreign language. Can you interpret the signs in this photograph?

## Key terms

**Profile** a short review which contains key facts about a person, object or process.

**3D** three dimensions; three dimensional.

**Symbol** something used to represent something else by association, for example $\omega$ represents angular velocity, © means copyright.

**Expert knowledge** specialist knowledge about a subject gained through education and training.

# 2.1.1 Interpret

When you look at an engineering sketch, circuit diagram or network diagram there will different types of information presented. You need to know which bits are relevant, and you need to be able to interpret what they mean.

The process that you need to carry out is no different to someone reading a page of music or a piece of text written in a foreign language. Beginners might be able to pick out the individual meaning for each of the notes or words, but do they really understand what is being presented when read as a phrase?

To illustrate the problem, access a search engine online (such as Google or a similar site) and look for the translate text option. Type in and translate this sentence into Estonian:

> *The electrical control unit is fixed to the frame of the power pack using rubber anti-vibration mountings.*

Now paste the translation back into the text box and convert it back into English. This is what you might get:

> *Electrical control unit is attached a frame pack, using a rubber anti-vibration.*

Similarly, translating the sentence into Polish and back, you get:

> *Guards are attached to the frame of the power pack with rubber anti-vibration mountings.*

Something has got lost on the way each time, perhaps because the software doesn't have expert knowledge about engineering. This isn't a trivial exercise: many UK companies have manufacturing facilities in Poland and other countries in which English isn't the first language. As accuracy is essential in engineering, clearly they need to use means other than search engine translators to commnicate information. So how do engineers ensure that there is no confusion about what is written in documents or presented in drawings?

To answer this question, we need to look at the type of information that engineers typically need in their work. There are three types of information to consider and interpret when communicating technical information:

- features which describe a product or system
- instructions for producing a product or system
- graphical information which aids written or verbal communication.


Can you identify the graphic **symbols** presented on this label and interpret what they mean?

## Did you know?

BSI British Standards is recognised globally as a producer of standards and information products that promote and share best practice in industry and commerce. The catalogue of over 27,000 British Standards can be accessed at the BSI website. A search facility allows you to find the one you need.

## Features which describe a product or system

At some point in your engineering career you will be asked to manufacture a component using machine and hand tools. Before starting work you need to know about the component's features, and these will usually be presented to you in a drawing or sketch. The starting point will be features relating to the component's physical appearance, such as the lengths of sides, diameters of holes and cylindrical surfaces,

**tolerances**, **surface finish** and **surface coating**. If the drawing or sketch has been produced to a recognised BS or ISO standard, you should be able to easily unpick the information presented.

Perhaps you are not involved with machining but are more interested in building and testing equipment. For example, you might be fitting together the valves, actuators and power lines of a **pneumatic circuit**. What sort of information do you need? A list of components and a layout diagram would be useful. You might also want to refer to BS2917.

## Key terms

**Tolerance** an allowable deviation from the desired size (no size can be achieved exactly).

**Surface finish** the roughness and waviness of a surface; also referred to as surface texture.

**Surface coating** substances applied to a surface after it has been machined, such as paint and chromium plating.

**Pneumatic circuit** a system that operates using compressed air.

**Heat treatment** a process that changes the mechanical properties of a metal by using controlled heating and cooling.

**Specification** technical requirements that a product or service must conform to.

**2D** two dimensions; two dimensional.

## Instructions for producing a product or system

Drawings and sketches are very useful, but unless a product is very simple they will not hold all the information needed to guide someone through the steps necessary for its production. Production refers to activities such as manufacturing by cutting materials, assembly of components, and processes like **heat treatment** and surface coating.

Drawings might be accompanied by documentation such as cutting lists, tool requirements, assembly instructions, operating procedures for testing circuits and anything else which will help someone to produce a product or system to **specification**. This may even include information about the plant layout. Specialist engineers and technicians will produce this type of documentation.

This documentation will be used by the production team. For example, a manufacturing engineer will look at a component drawing and decide on a machining sequence and the tooling requirements. This information is then passed as a paper or electronic document to the person operating the machine tool that will be used to manufacture the component.

## Graphical information which aids written or verbal communication

So far we have considered drawings and sketches, and the associated written documentation, used in a production environment. Now think about a different situation. Suppose you are writing a technical report or putting together a PowerPoint presentation. The text is fine, but you are unsure if it will fully get the message across and you decide to include some graphics. What form might these take? These are the most commonly used options.

- Illustrations such as hand-drawn pictures and digital images imported from a camera.
- Technical diagrams showing how components fit together. Good examples can be seen on manufacturers' websites when looking for replacement parts.
- Sketches that, for example, show how to assemble components or how to install a product into a service position.

## Activity: Communicating information

Find an everyday object such as a mobile phone or a piece of equipment used in a workshop and produce a 3D freehand sketch of it. Do not use any words on your sketch.

Give the sketch to a colleague and ask them to redraw it as three **2D** views. These drawings should then be passed to a third person, who is asked to turn the 2D views into a 3D sketch. When completed, this sketch is passed back to you.

How accurately does this final drawing compare with the item you initially sketched?

Is there anything missing? Did anything get lost in translation?

## Case study: Ryan proposes a better way to do a job

Ryan is a maintenance technician for a company that produces carbon fibre body struts for commercial aircraft. When he services the filament winding machines he follows procedures set out in a service manual. There are 10 machines, each requiring a monthly service.

Ryan has been doing the job for about two years and has come up with an idea that he thinks will reduce the servicing time for each machine by about 4 hours. Suppose you are Ryan's supervisor. He arranges a meeting with you to discuss his idea.

1. What questions will you be asking him?
2. What evidence do you expect him to present?
3. Ryan will need to clear his suggestions with the manufacturers of the machine. How should this be handled?

## Assessment activity 2.1

P1

BTEC

You only need to carry out **one** of these tasks. Choose a task that relates to your area of interest.

1. Find a drawing or a sketch of a component that is presented in 2D using orthographic projection and to drawing standard BS8888. From the drawing, identify and describe six pieces of technical information that relate to features of the component, such as datum positions, dimensions, tolerances and surface finish.
2. Find a circuit diagram of a pneumatic system, presented in accordance with BS2917, and identify and describe six pieces of technical information that relate to features of the circuit, such as power source, conditioning device, flow lines, control valves, actuators and sensors.
3. Find an electronic circuit diagram that is presented in accordance with BS3939. Identify and describe six pieces of technical information that relate to features of the circuit, such as power source, voltage regulation, and output characteristics.
4. Find an IT network diagram that is presented in accordance with a current drawing standard and that includes a range of hardware items. Identify and describe six pieces of technical information that relate to features of the circuit.

### Grading tip

You are looking for technical information that could be used to help you manufacture or test the product.

## 2.1.2 Engineering sketches/circuit/network diagrams

People involved with the production of engineering graphics should present their work so that it conforms to relevant British (BS) and international (ISO) standards. This is important because it will prevent any misinterpretation of the information being communicated, but it does assume that the person reading the diagram is also familiar with the standards.

Because of the way that businesses operate globally, components for a product could be manufactured in several different countries and then brought together for assembly. Think about what happens in car manufacturing where, for example, engines might be designed in the UK, manufactured in Spain and then brought to Germany for vehicle assembly. The drawings and documentation associated with the manufacturing process are moved around electronically and read by many different people.

In Unit 16: Engineering Drawing for Technicians you have the opportunity to develop your sketching and formal drawing skills, and there is considerable overlap with this unit. For now, let's consider three particular aspects of engineering graphics.

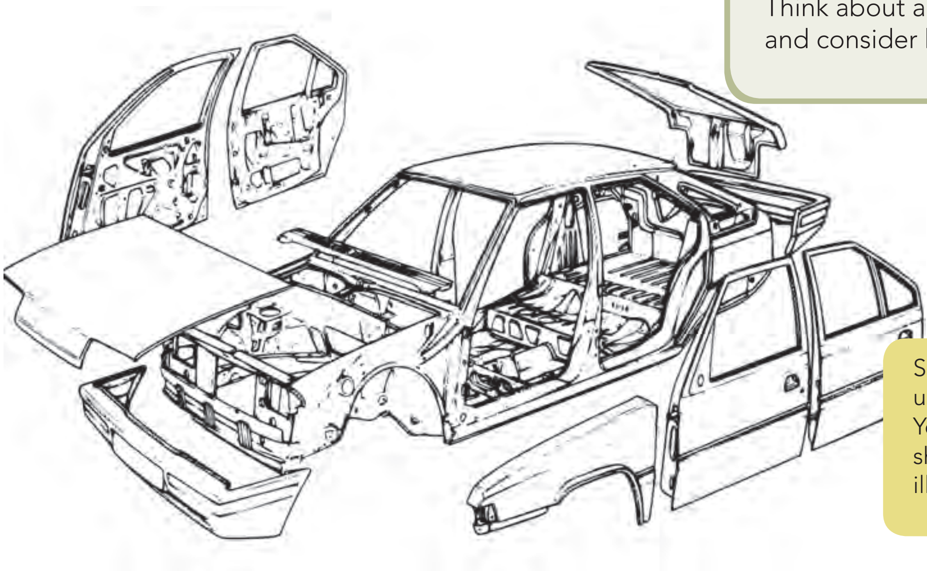
## Freehand sketching

Why produce a freehand sketch when we have access to CAD software and formal drawing methods? Many famous engineers have claimed that they sketched out their ideas for a new product on the back of an envelope. This may be true, but you would need a very large envelope for something like a wide-body aircraft or a motor vehicle. What they are really implying is that freehand sketching is a quick way to get ideas down on paper and it allows for the free flow of ideas. People can sit round a table, look at what is drawn and then add or take away detail – this is why sketching is the ideal way to start a design project.

Pictorial sketches presented in 3D are a good way to give an overall impression of what a product looks like. If specific detail needs to be shown, it may be better to sketch in 2D with views laid out using **orthographic projection**. Sketches can include calculations and notes, so that they can be passed to the designers responsible for producing detailed component and assembly drawings.

The process of sketching, whether it is totally freehand or done with the aid of a rule and set square, should follow some basic guidelines:

- ensure sizes and shapes are in good proportion
- work off centre lines and lay out views in the same way as for formal drawing
- represent standard features, such as tapped holes, with **conventions** as detailed in the relevant **drawing standard**
- produce work that is neat and easy to read
- provide adequate labels.



### Key terms

**Orthographic projection** the representation of a 3D object by a set of linked 2D views, such as plan, front and side.

**Conventions** accepted ways of representing the features of an engineering component in a drawing.

**Drawing standards** a publication that specifies how an engineering drawing should be produced so that there is no ambiguity in its presentation.

**Annotations** written notes and numerical information added to a drawing.

**Hydraulic** a system which operates using compressed oil.

**Schematic** a representation of a component using a graphic symbol.

Unless they are very detailed or relate to extremely simple components, it is not recommended that sketches are used for manufacturing purposes. It is much safer to convert a sketch into a formal engineering drawing, so that it can be properly checked and approved for use.

### Activity: Freehand sketching

USB flash drive memory sticks are a popular way of storing data. They are small, reasonably cheap to buy and people often end up with a drawer full of them.

Design a simple desktop caddy that will hold 10 standard-sized memory sticks.

Prepare a freehand sketch with **annotations** of the caddy and discuss your design proposal with a colleague.

Think about a suitable material for the caddy, and consider how it might be manufactured.

Some design technicians in industry now use CAD systems to sketch out their ideas. Your sketch of the memory stick caddy should be drawn freehand, but it should illustrate some of the details of your design.

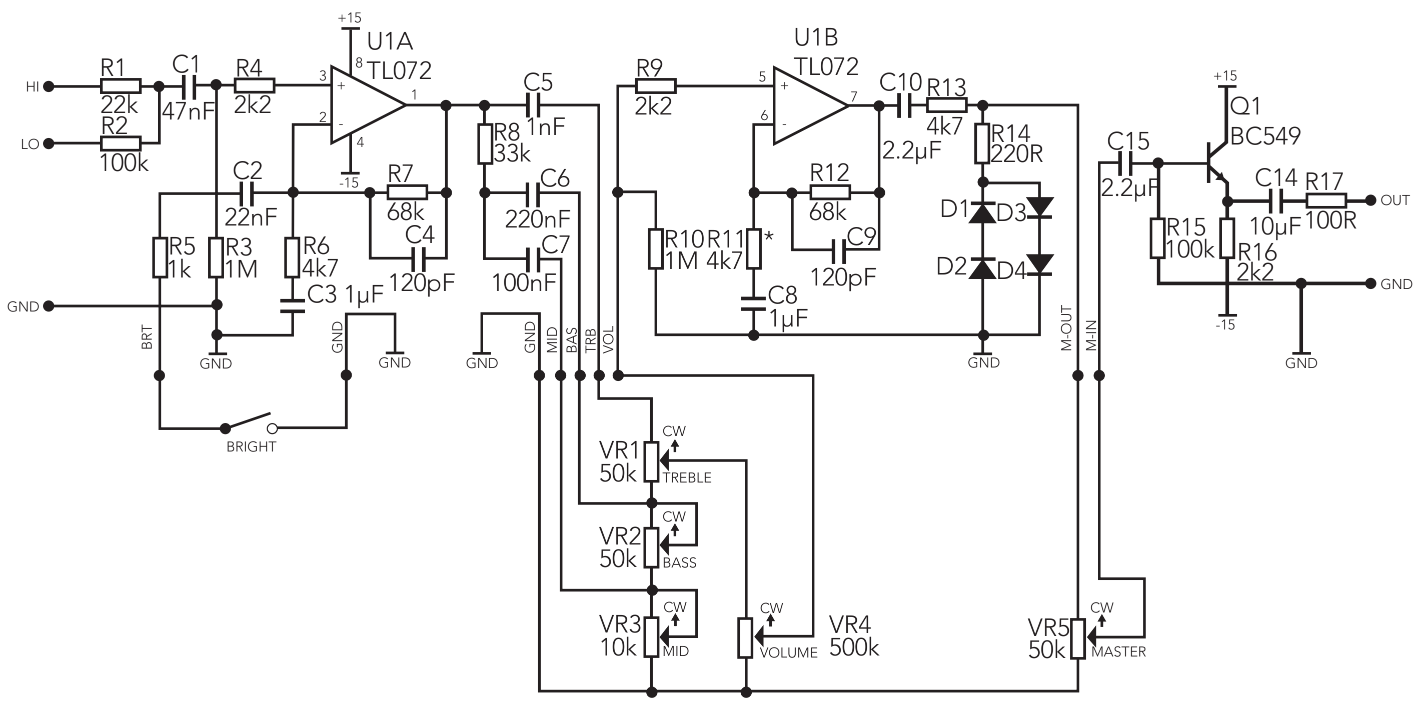
## Circuit and system diagrams

Circuit and system diagrams show the functional relationship between components and are used for assembly, testing and fault-finding purposes. Typically, they are referred to when working with electrical and electronic circuits, fluid power systems (pneumatic and **hydraulic**) and IT networks. Circuit diagrams show how the various components are linked and are usually **schematic**. You should be aware that the position of a component in a circuit diagram does not necessarily indicate its physical position in an assembly.

A circuit diagram is very often accompanied by a parts list, assembly notes and values for test measurements. For an amplifier, these would be the measured voltages at different points in the circuit. In a hydraulic circuit, pressure readings would be made.

System or network diagrams may show how components are linked or can be in the form of block diagrams, which trace through how the system operates. For example, a block diagram may be used to show the sequence of events as a central heating boiler fires up and switches off.

IT networks have varying levels of complexity. Think about the one installed at your college or place of work. If there is a communications problem, the IT technician will need to look at the system diagram and carry out a fault-finding procedure. You can find examples of IT network diagrams on the internet or on electronic databases. Print off an example, and note how the 'boxes' link together. Annotate this diagram with brief notes that explain the functions of the equipment shown in the network.




This circuit diagram is for a guitar pre-amplifier. See if you can obtain a circuit diagram for a piece of equipment you have at work or at college. It is useful to compare the circuit diagram with the actual circuit in the equipment.

A simpler form of system diagram will be used to provide information to consumers. For example, a telecommunications company might provide a simple system diagram for customers linking up to broadband at home, together with instructions about setting up the router and linking it to a computer. This could be supplemented with more instructions about getting it all to work. There may even be the option of verbal communication, with purchasers invited to ring up customer service if they have problems so that they can be talked through the set-up procedure.

### Activity: Using graphics to aid understanding

Some GCSE students from a local school are going to spend a day in the apprentice training workshop of your company. One activity they will be carrying out is drilling a 12 mm diameter hole through a 5 mm thick mild steel plate clamped in a pedestal drilling machine.

The instructor wants to be sure that the students follow the correct sequence of events when drilling holes and asks you to prepare a worksheet.

1. On an A4 sheet of paper draw a flow diagram for producing the hole.
2. Add sketches showing how the plate should be clamped. These can be drawn separately and pasted onto the diagram.
3. Show your work to a non-engineer. Can this person understand what is going on? If there is any ambiguity, modify what you have drawn and sketched.

## Conventions and standards

It is important to use the correct graphical representations and drawing standards when producing sketches and diagrams. This prevents confusion and ambiguity.

The starting point is to decide on the layout of your sketch or diagram. If you are sketching a component, then you need to decide if it is to be in 3D or if you are going to present it in an orthographic projection using one or more views. This will depend on your intended audience: 3D is good if you are trying to sell an idea and you want to give an overall impression of your product, but an orthographic projection may be better if you are passing your idea on to a detail designer.

Circuit and network diagrams are usually drawn in 2D but it is still important to think about how you want them to look on paper, so you need to think about the correct positioning and leave room for notes.

Sketching components will involve using lines and cross-hatching and applying dimensions and tolerances, all of which should be done in accordance with the appropriate British Standard or International Standard. If there are specific requirements about the surface quality of an object, and you know what type of manufacturing process is to be used, then you can specify the surface finish using the 'tick' symbol.

An assembly drawing will always be accompanied by a parts list. There are recommended standardised ways of setting these out, so that if a product is modified the parts list can be easily updated.

When producing circuit diagrams it is important to use the correct component and connection symbols. For example, if you are drawing a hydraulic circuit then the filters, pressure regulators, valves and actuators will be shown using symbols. Connecting pipework, high pressure supply and low pressure return connections will also be shown using diagram conventions.

The conventions and standards for different types of drawings are set out in separate British Standards. Engineers producing and interpreting engineering graphics must be familiar with the British Standards (BS) and International Standards (ISO) that apply in their industry. You should find out which type of drawing each of these British Standards relates to:

- BS8888
- BS4500
- BS3939
- BS2917
- BS4058.

### Key term

**Hard copy** a physical (not electronic) version of a document.

## Case study: Ali solves a networking problem

Ali works for NDEB Ltd, a small business that manufactures printed circuit boards. The company has a network of computers and peripheral equipment connected to a central server. Ali is an IT technician responsible for keeping everything working and for installing new pieces of equipment.

NDEB has just taken delivery of new computer-controlled machine and it is proving difficult to link this machine to the IT network. There are software and connector incompatibility problems – the machine refuses to 'see' the network.

The manufacturing director is very concerned and asks Ali to sort out the problem as a top priority.

Suppose you are Ali. How will you go about this task?

## Assessment activity 2.2

P2 P3

BTEC

You only need to carry out **one** of these tasks. Choose a task that relates to your area of interest.

1 Find a relatively simple engineered component, such as pulley bracket or a toolmaker's clamp, and produce a freehand sketch of it in 2D and 3D.

2 Produce a pneumatic circuit diagram comprising at least 10 different components to a standard that is acceptable to industry.

3 Produce an electronic circuit diagram comprising at least 10 different components to a standard that is acceptable to industry.

4 After new manufacturing machines have been installed into a work area, they are commissioned. Using network diagrams and test equipment, technicians carry out procedures to ensure that all the various machine and interface systems are functioning correctly. Construct your own example of a network diagram.

Your work – whether it is a sketch, a circuit diagram or a network diagram – should be presented using the correct BS standards, symbols and conventions. Identify these by adding brief notes to a **hard copy** of what you have drawn.

### Grading tips

For P2, your sketch or diagram must be sufficiently detailed so that it will effectively communicate technical information to a third party. It is good practice to use a drawing template so that you can include information such as your name and job title, and the date your produced the work.

To achieve P3 you will need to demonstrate that you can identify and use standards, symbols and conventions.

## Did you know?

The phrase 'a picture speaks a thousand words' is attributed to a Chinese emperor who lived about 4000 years ago. The saying is still relevant in the twenty-first century, but engineers are more likely to say 'a drawing is worth a thousand words'. This book contains many images: pick one of them at random and think how many words might be needed to describe it fully.

## PLTS

Thinking about what you are going to sketch or draw requires creativity. It also is quite likely that you will have discussed and reviewed your ideas with your tutor. This will help you generate ideas and explore possibilities.

# 2.2 Be able to use verbal and written communication skills in engineering settings

## 2.2.1 Written work

The first contact that potential customers have with a business is usually through the written word. For example, a prospective customer might read the company website and its promotional literature, or might have been sent letters and emails. If this writing is badly presented or ambiguous, or if it contains spelling and grammatical errors, it will be difficult to read. It will certainly not impress any potential or existing customers, and they may decide to take their business elsewhere.

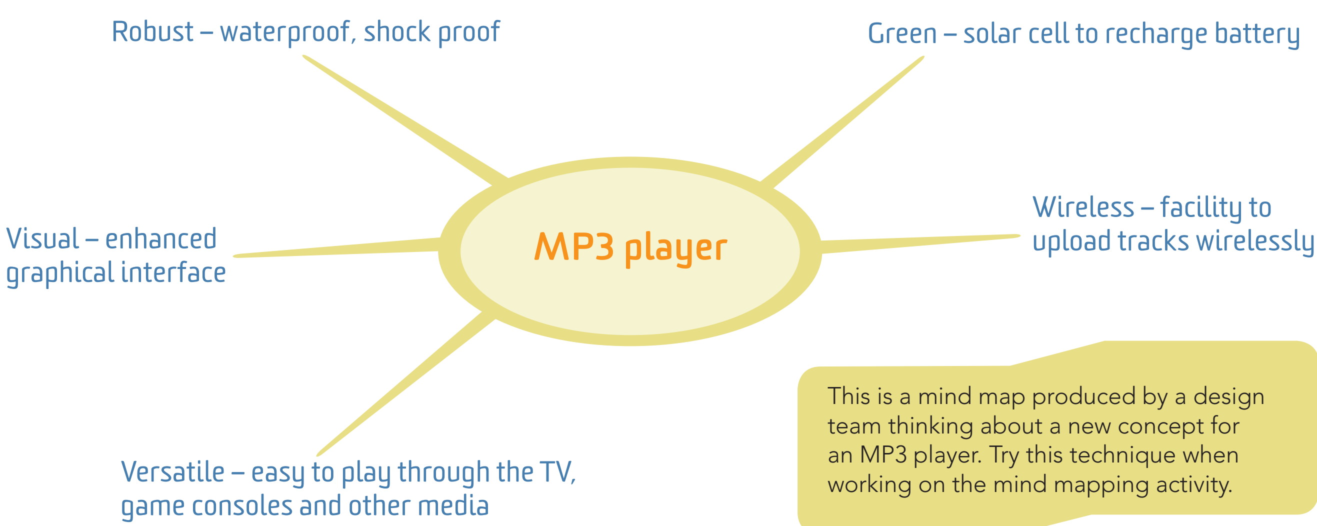
Much of the communication in an engineering business is by use of technical drawings and graphics, but if the accompanying documentation is poor it will cause confusion and doubt in the minds of people looking at it. CAD systems make it straightforward to produce 'perfect drawings', and design and simulation software packages can perform complex calculations, but writing good documentation cannot be automated, and it requires special skills on the part of the writer.

### Note taking

When taking notes at a meeting it is important that you capture the key points being discussed so that you can follow up by writing a full report of the discussion (if required). You can take notes on paper, but many people prefer to use a laptop computer so that they can easily fill out headings and move blocks of text around. Making a list of key points is a simple way of getting information down on paper and could act as prompts when carrying out further research or follow-up activities.

When you are working on the design and project units on this engineering course, there will be times when you need to bounce ideas around between yourself and other people. Producing a mind map on a flip chart or interactive whiteboard is a good way to get started. You write down a central key word or idea, and then create a spider's web of thoughts, words or ideas around this idea. Mind maps encourage creative thinking, and sometimes an initial 'off the wall' idea which seems illogical may, in fact, be the one to develop. 'Thought showering' is another term that people use when thinking creatively or problem solving in a team.

At the end of a productive mind mapping session, it is usual to agree an action plan so that ideas can be taken forward. This could involve drawing up a flow chart which sets out the steps to be followed and the names of people responsible for specific actions.




This is a mind map produced by a design team thinking about a new concept for an MP3 player. Try this technique when working on the mind mapping activity.

## Activity: Mind mapping

Suppose you and a colleague work in the design department of a company that makes products for the leisure market. A caravan manufacturer wants your company to design a ventilator unit that can be fitted to new caravans and motor homes or bought as an accessory by owners for retrofitting.

Your manager asks you produce a list of eight key features that the new product must have. Start by producing a mind map, and use it to identify the key features of the product.

## Writing styles

The writing styles used in engineering are varied, and they include different styles appropriate for letter and report writing, for memos (paper based and email) and for faxing information.

Letter writing ranges from a simple one line email or handwritten note to a formal letter presented on headed company notepaper and signed by hand. The degree of formality depends on the relationship between the people who are communicating. When writing to someone for the first time it is good practice to use a formal tone; you can always adopt a more familiar style as you get to know them.

For most types of written communication the key to success is to be succinct and to keep to the point. People in business do not have the time or patience to read long documents padded out with unnecessary words, so short paragraphs and bulleted headings make for simpler and more accurate reading.

Paper-based memos are rapidly being replaced by electronic forms of communication such as emails and texts. However, if you do write a memo, be sure to include this information:

- name of intended recipient
- name of sender
- subject
- date.

Writing a good technical report requires a fair degree of skill, and this is something you will practise and develop on this BTEC National programme. There is no 'one size fits all' rule for preparing reports, and many businesses have their own special requirements.

### Did you know?

CC means carbon copy. If you want to send an email to group of people and you use BCC (blind carbon copy), then each person receiving the email will not see the other people's addresses.

When preparing a report, it is worth checking to see if there is a **template** into which you can type or write.

When you are writing, keep in mind who will be reading your report. Suppose you are writing a report presenting a very detailed design proposal, which contains drawings, text, calculations, edited research material and proposals. A subject specialist, such as your tutor, will read the document right through and pick up on all you have written. A busy training manager or director at your place of work may be more interested in just getting an overview of what you are proposing. To help them, it's worth including a summary section at the start of the report with key facts, findings and recommendations.

Beware of using shorthand that may not be understood by everyone reading your work. When preparing documentation you should explain the meaning of any acronyms that you use. An acronym is a word formed by the initial letters of a name or phrase, such as sonar which is formerd from the first letters of the words '**so**und **n**avigation **a**nd **r**anging'. Most people understand what BBC1 means when looking through the television listings, but the meanings of many other acronyms are much less well known. You will come across many acronyms related to education in your course. Make sure you know what PLTS, FS and BTEC stand for.

### Key terms

**Template** a document that has topic headings and page layouts already set up.

## Activity: Summarising

Write a 100-word overview of the material you have just read on note taking and writing styles.

## Proofreading and amending text

In a professional context, such as business and engineering, any written work that will be read by people other than the writer should be grammatically correct, contain no spelling mistakes and use proper punctuation. This can be difficult to achieve, even with the help of the spell and grammar checkers in a word-processing package. Many people who produce and write reports and books (including the publishers of this book) employ the help of proofreaders. In the past, a proofreader would mark up any mistakes on a paper copy of the text using a coloured pen; now many proofreaders mark up text electronically on screen using the highlighters available in computer programs.

You can also proofread your own work by sitting back and quietly working through the text. The problem here is that many people skim read, particularly when their writing has been worked on several times and they can almost remember it word for word.

When you ask someone to proofread a document or technical report, be careful to make sure that they do not change the meaning of a block of text when they make amendments. They may not have the in-depth technical knowledge that you have, even though their English writing skills may be excellent.

Written text can be quite difficult to follow if it is badly presented with, for example, an unclear typeface, long sentences and huge paragraphs. It is much better to break text down into manageable blocks and, where appropriate, to use bullets or paragraph numbers. This is particularly important for technical reports. You may have some experience of improving the presentation of reports: think about a report that you have written and which you have tidied up following discussion with your tutor.

When you amend text, think about the people who will be reading your work. You need to capture and keep their attention. It may be worth adding images or diagrams to lighten the appearance of the page, or perhaps think about adding some colour.

We are moving towards a paperless environment, with all documentation being written and worked on electronically. This is fine, but many people who write technical reports still prefer to print it out so that they can spread the document out and look over the pages. Errors are usually easier to spot, amendments can be highlighted with a marker pen and corrections can be made to the original document in one hit.

Amendments to word-processed documents can be tracked using the 'track changes' command. This is a really helpful if several people are involved with writing a report over a period of time. It provides an **audit trail** of their amendments and a clue to their thoughts.

### Key terms

**Audit trail** a series of records so that you can go back and track what occurred.

### Activity: Proofreading

Work with a colleague on this activity. Each of you should select a document that you have prepared with a word processor. Email your documents to each other and then proofread each other's document.

Return the amended documents and look over the changes. Discuss your findings.

### Functional skills

Proofreading a technical document will help improve your English skills (reading).

## Presentation

This book uses a range of writing and graphic styles. The aim is to capture your attention and to make you want to read it from cover to cover.

It is a useful exercise to see how these styles have changed over the years. A useful exercise is to find an engineering textbook written several years ago, and then compare the style of presentation between now and then. Ideally you should look for one covering the same level and type of course. You might find one tucked away at the back of a college teaching room. Start by picking a page from this book and one from the old one, and count up the number of words on each page. Then look at the font style and size. Which book is the most attractive to work with?

You need to ensure that any document you produce is pitched at the right level for the intended audience and is set out clearly.

## Diaries and logbooks

Keeping a logbook or diary is a good way to maintain an up-to-date record of events as they take place. Many people keep electronic notebooks, but most of the great inventors and engineers wrote everything down by hand.

Using a diary is a good way to capture information that will help you plan and prioritise work schedules, but when you need to record something in more detail it is better to use a logbook. Logbooks are used to keep detailed records of what happened during a project. Your course logbooks should contain text, calculations, sketches, drawings and images, as well as feedback and comments from your tutor, mentor or supervisor at work.

Good personal organisational skills are needed if a diary or logbook is to be kept up to date. Discuss with your tutor an agreed format for a logbook that can be used to record the progress of an engineering project. Set up a time frame for how often it should be reviewed, and design a tracking sheet which can be signed off at each review meeting.

## Graphics

Graphs, charts and diagrams form a significant part of the graphical communication used by engineers when they prepare reports and documents. It is very straightforward to insert them into a text-based document by cutting and pasting from a compatible software package. Most engineering businesses use Microsoft Office, and this allows easy import of files from digital cameras, scanners and other peripheral equipment.

Many files that you will be sent in engineering or which you download from the internet will be in 'pdf' format. This ensures that the layout of the document is not changed in any way when it is opened. This can happen when documents in other formats are opened in a different application or on a diifferent system to that on which they were created. Make sure you know how to save an electronic report created in doc (or docx) format in a pdf format.

### Did you know?

The file extension jpeg was named after the Joint Photographic Experts Group. It is an agreed international standard for the compression of photographic images. The standard has been around for about 20 years and gives a compression ratio of about 10:1 for a typical camera or scanned image.

### Functional skills

Writing about Beth's job role (see case study below) will help develop your skills in English (writing).

## Case study: Beth helps produce electrical product guides

Beth works in the marketing department of a company that manufactures consumer electronics, such as digital radios and DVD recorders. Each time a new product is brought out, the company produces an operating guide. First drafts are written by the engineers who have designed the equipment.

It is Beth's job to make sure that the guides can be understood by the general public, some of whom will be technophobes. Beth will proofread and amend a draft without destroying the technical accuracy of what has been written and drawn. Her brief is to produce a user friendly operating guide.

Suppose you are Beth.

1. How do you start the process of proofreading and amending a draft?
2. You are always given a copy of the full technical specification for the product as well as the draft operating guide. Why is this?
3. How will you track any changes which are made?
4. What notes will you write?
5. At what stages in your process will you involve the engineers?
6. Who should have responsibility for signing off the completed document?

## 2.2.2 Verbal methods

Effective verbal communication is a vital skill because it is important that everyone involved in a conversation has a clear understanding of what has been said and agreed. Unless a written record is kept, verbal communication can be an unreliable way of giving and receiving information. There are many situations where engineers speak and listen to each other, but these usually fall into one of two broad categories:

- informal discussions, such as face-to-face meetings or telephone calls, which are unrehearsed but are often based around lists of points to be covered
- formal presentations to a group of people all requiring the same information, usually supported by presentation graphics and handouts.

Engineers are usually very good at finding solutions to complex technical problems and turning ideas into products and services, but some are not so good at liaising with other people or presenting their work to a wider audience. The aim of this next section is to give you guidance on how to develop your listening and speaking skills so that hopefully you feel confident to converse at all levels within in an organisation.

### Speaking

We do this all the time, and depending on who we are with we adjust our language between more formal and informal styles. The same rules apply when we are speaking as when we are writing to someone. Start by being formal and soften up as you get to know them better. It is important, and sometimes difficult, to strike the correct balance. If a customer rings up a company to complain, it will really make them angry if you call them 'mate' or use their first name. Listen, be polite and either address them formally – Mr Smith, Ms Smith etc – or don't use their name at all.

Think about what happened last time you were cold called by a telesales person. From the start of the conversation did the salesperson assume that you were a friend and it would be OK to be on first name terms? It's a technique designed to suck you into a conversation, so that you end up believing what they are telling you. They are not your friend, they just want to earn a commission by making a sale.

Engineers often have to be persuasive when talking to people so that they can get their message across. If you are going to be persuasive, then make sure you are fully prepared before you start to speak. Do you have the facts and figures in your head or on a prompt sheet? Are you able to take questions? What happens if you don't know the answer to a question? Do you look confident? Will people trust your judgement?

### Listening

When someone talks to you, they can adopt one of two approaches. The first is to speak *at you* in a bombastic way, probably showering you with their opinions, facts and other information. Some teachers adopt this approach and very often their students take little notice of what they are saying.

The other approach is to speak *with you*. Even in a group situation, the conversation will appear to be personal with each listener being made to feel included. This is the preferred approach, but it does require effort from the listener as well as the speaker. It requires active listening. The best way to achieve active listening is to make eye contact with the speaker, raise questions at suitable points, allow the speaker to continue even if you disagree with what is being said, and generally be good mannered.

A successful business is one that has good products and employs staff who talk to each other. Because an engineering company relies on teamwork, you will find it really helpful to your career if you develop good speaking and listening skills.

### Body language

Body language is an interesting topic. Think of someone you took either an instant liking or disliking to from the first time you met, perhaps before they even spoke a single word. Why was this? Was it their physical appearance, did they need to take a shower, or was it something in the way they behaved? Body language and personal chemistry are seemingly indefinable properties. Actors use these attributes to great advantage; in one film they might play the good guy and we all love them, in another film they are a horrible person who scares or revolts us.

When conversing with people be careful with your body language. Be too familiar, and people will be put off. Appear too cold and calculating, and most people won't like you. Striking the right balance requires great skill and can only be developed through practice.

## Making a presentation

You will need to put all these skills into practice when making a presentation. As well as the written skills in preparing your slides to the required format and quality, you will need consider:

- making a good introduction
- delivering the main content
- finishing up
- answering questions
- engaging with the audience
- making a point
- maintaining eye contact
- ensuring clarity of speech
- demonstrating positive body language
- timing.

Think about the principles involved under each heading. For example, what's a good way to start a presentation? Should you stand on your head, cough loudly for a few minutes or introduce yourself?

### Activity: Hearing, listening and communicating

Form a small group and discuss each of these statements.

*I hear what you say, but I'm not listening.*

*There are ways to improve listening skills.*

*I agree to disagree with you.*

*We respect others' opinions.*

## Assessment activity 2.3

P4 P5 M1 D1

BTEC

Choose an engineering topic in which you are really interested and which you can use as the basis for a presentation to be made to other members of your group. For example, you could talk about a famous engineer (such as Isambard Kingdom Brunel) or an aspect of engineering that interests you (such as CAD). You should plan to speak for about five minutes and have available a one- or two-page A4 summary leaflet which the audience can take away.

- Put together an outline of your presentation in note form and go through them with your tutor. Following this discussion, amend your notes.
- Prepare the leaflet. It should be around 250 to 300 words in length, and include at least one image, chart or diagram.
- Show your amended notes to a colleague and ask for feedback. Based on these comments, amend and refine your document further.
- Now prepare what you are going to say. Consider the different ways of giving your talk and select the one you think most appropriate (and keep evidence of this selection process). For example, you could make a formal presentation using PowerPoint slides, or run a question and answer session supported by images projected onto a screen, or deliver a semi-formal presentation using a flip chart.
- Make the presentation and take questions.

### Grading tips

For **P4**, you will need to show that you can take notes and turn them into a piece of properly laid out text, which includes graphics. Your charts, diagrams or images should be linked to the text using figure numbers and titles. Plan your research and record what you did in a diary or logbook. Proofread the leaflet.

Your evidence for **P5** will be obtained through tutor observation records. These will record the discussion you had with your tutor and your presentation to the group. You need to demonstrate that your speaking, listening and body language skills complement each other and you are to able communicate effectively.

You can achieve higher grades by developing this work. To achieve **M1** you need to evaluate the content of your leaflet, come to a conclusion about its quality and identify ways in which it can be improved.

The key to achieving **D1** is to be able to reflect and evaluate. You must fully justify your choice of the communication methods that you used and be critical about the reasons for rejecting the other option(s) that you considered.

# 2.3 Be able to obtain and use engineering information

Engineers use information sources when designing, manufacturing and testing products. It is very important to have an effective search strategy and to establish that data obtained from any information source is valid and correct. Much of the information used in engineering is in electronic form and it is very easy to fall into the trap of information overload. A strategy is required for identifying what material is really needed so that irrelevant or suspect data can be filtered out. This is particularly important when writing reports which include research data placed in an appendix.

## 2.3.1 Information sources

Information sources can be classified into groups, including:

- sales catalogues, used when purchasing components for incorporation into a product that is being designed
- published scientific data, such as the properties of materials, which is factual and presented in a variety of forms
- British and European standards
- company databases of reference material, built up over many years, which contain information such as the results of product performance tests and reliability data.
- company drawing and documentation libraries.

### Non-computer sources

Despite the increasing use of computers to store and distribute information, there are still many reference materials produced in hard copy format.

- Many engineering textbooks (like this one) and reference books are still published each year. If you are using a book, it is important to make sure that it is up to date, particularly where it makes reference to standards and legislation that may have changed since the book was published. Always check the dates of first publication and revised editions.

### Activity: Finding information

Suppose you work for a company which manufactures electrical equipment for cars. You need to find this information:

- the results of performance tests carried out on alternators
- a customer design specification
- chemical analysis data relating to waste water produced during the manufacturing process
- hardness tests on aluminium stock delivered to the factory
- the results of safety tests carried out on electrical power tools used in the assembly department.

Where would you look for this information? The information is likely to be held by different departments in the company. Where could each piece of information be found in the company?

- Technical reports, either in house or for general use, are often produced in hard copy.

  In-house reports are like the ones you will prepare during this BTEC National programme or at your place of work. Only specific people are interested in reading them, and very often they will contain confidential information. For example, confidential reports might contain test results or design proposals, which would be of interest to business competitors if they were made generally available.

  General use reports, such as *Which?* publications containing the results of product testing, are often available to buy. Published reports are usually covered by copyright, which means that material in them cannot be reproduced without the writer's permission. If you are going to use statements from an **open source** report, then it is good practice to

acknowledge in your writing where they came from. A simple reference in the bibliography is all that is needed.

- Institute and trade journals are good sources of information because the material is often specific to a particular industry. You must usually buy an annual subscription to obtain a journal. Sometimes you can only buy a subscription if you work in the industry.
- Data sheets and test results data are concise ways of presenting information, and they remain very popular in places such as design offices and maintenance departments. The sheets can be filed in a ring folder, and it is quick and easy to refer to the information you need. Several pages of A4 can be laid out on a table and overviewed very easily.
- Manufacturers' catalogues are still a very popular way of presenting information, even though they may contain many pages and require regular updating. They are robust and can be used in places where IT equipment is not available or will not work.

### Key terms

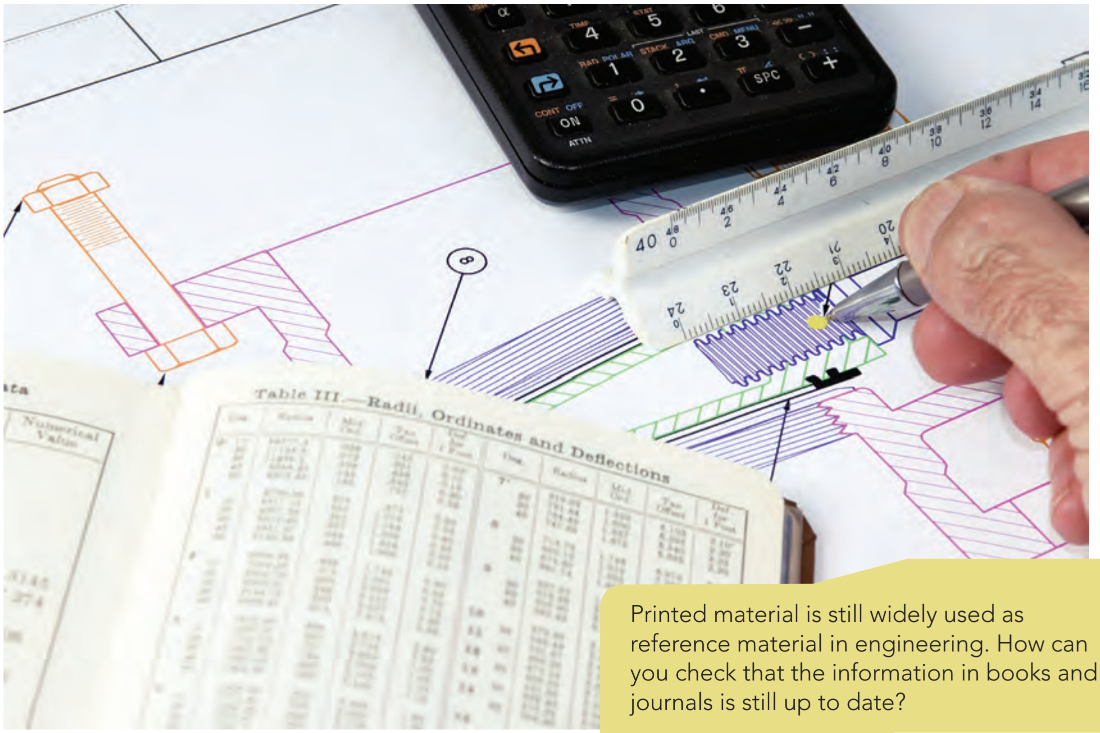
**Open source** freely available.

**ISP** an internet service provider.

## Computer-based sources

There are many computer-based sources of information.

- An increasing amount of information is stored online. Online access is via the internet or a company intranet. Internet access is done using a fixed or mobile connection and linking through an **ISP**. Intranet access is internal to a business and works through the computer network linked to a database held on a company server.
- CD-ROMs are a useful resource because they can be built up into a catalogued library, but, as with paper-based sources, they need to be regularly updated. CD-ROMs are relatively robust and they can used in manufacturing environments where magnetic interference might corrupt data held on USB flash drive memory sticks. The type of data held on CD-ROM includes manufacturers' catalogues, service manuals, and specialised software. To access some types of data, for example test results, you may need an access code or password.
- Spreadsheets holding design calculations and test results are normally filed centrally in a company computer. Engineers and other people who have authorised access can login to access the data.
- Databases holding information on a company's products are filed centrally in the business.




Printed material is still widely used as reference material in engineering. How can you check that the information in books and journals is still up to date?

## Case study: Kalpa, sales engineer

Kalpa is a sales engineer working for Pyco Electronics plc. The company manufactures electrical connectors that are used in motor vehicles, computers and consumer electronics. There are two main product ranges:

- 12V, 24V, 120V and 240V power connectors
- data connectors, such as USB, parallel and serial connectors.

The company has a huge database of components, which can be accessed online or in printed catalogues.

A typical order from a Pyco customer might be for half a million units worth about £200,000, so it is important that the correct connector is ordered.

Kalpa's job is to prevent customers from ordering the wrong components.

1. What do you think is the significance of Kalpa's job role for both the customer and Pyco?
2. A new customer contacts Kalpa. What do you think happens next?
3. What specific details will Kalpa check after a sales order has been raised for the customer?
4. How much technical knowledge does Kalpa need to do her job?

### Did you know?

The commercial use of the World Wide Web started in 1995. Before that date few people had heard of the term 'www'.

## 2.3.2 Use of information

Once you have picked up some information, what do you do with it? Are you able to confirm its accuracy? Is it primary or secondary data?

An example of primary data would be the results you collect when carrying out an experiment. Assuming you accurately read and recorded the experimental results, then this primary data will be correct. Suppose you give these results to someone else for processing, and this person carries out calculations, plots graphs and writes a report that does not include your original figures. If a third person now looks at the report, what they see is secondary data. They will either have to accept the figures in the report or, if they want to dispute anything, then they must refer back to your primary data.

When sourcing information from the internet, do try to ensure that the site is reputable and provides accurate information. Your tutor will give you guidance on the best sites to use to obtain specific information. If you enter 'health and safety at work' into the search box in Google, you will get over 130 million hits. Many of these hits will be to sites offering to sell information or providing their own interpretation of health and safety legislation. What you really want is some good primary data, and the place for that in the UK is the Health and Safety Executive's website.

Having found information, you will want to put it to use. For example, you might have conducted an information search because you wanted to solve an engineering problem such as calculating the dimensions and mass of a load-bearing component made from stainless steel. To do this, you will need information on the tensile strength and density of stainless steel, the factor of safety to be applied and the formulae for working out cross-sectional areas and stresses.

## Worked example: How to use information

A design proposal involves fixing chromium-plated steel brackets onto an aluminium motor casing using titanium set screws. The assembly is to be part of a drive unit for a power boat.

We need to investigate the electrochemical corrosion problems that will occur. How should we go about this task?

First, we need to access the electrochemical (galvanic) series (see Table 2.1).

The next piece of information we require is about the corrosion properties of base and noble metals. Common knowledge tells us that base metals are more likely to corrode than noble ones when combined as a galvanic cell.

Sea water acts as an electrolyte – this fact can found by looking for information on the internet and checking in a materials textbook (such as *Materials for the Engineering Technician* by RA Higgins). These data sources also tell us that the bigger the difference in electrode potential, the higher the rate of galvanic corrosion.

Using all the data we have accessed, we can now come up with an answer. Titanium and aluminium are close together in Table 2.1, so there will be very little reaction between them. Chromium is higher up the table, and the potential difference between it and aluminium is 0.74 – 1.66 = 0.92 V. The aluminium will corrode in the vicinity of the bracket.

**Table 2.1:** The electrochemical (galvanic) series

| | **Metal** | **Electrode potential (volts)** |
|---|---|---|
| **Noble metals (cathodic)** | Gold | +1.50 |
| | Silver | +0.80 |
| | Copper (Cu+) | +0.52 |
| | Copper (Cu++) | +0.34 |
| **Reference** | Hydrogen | 0.00 |
| | Iron (Fe+) | –0.50 |
| | Lead | –0.13 |
| | Tin | –0.14 |
| | Nickel | –0.25 |
| | Iron (Fe++) | –0.44 |
| | Chromium | –0.74 |
| | Zinc | –0.76 |
| | Titanium | –1.63 |
| | Aluminium | –1.66 |
| | Magnesium | –2.37 |
| **Base metals (anodic)** | Lithium | –3.04 |

Another important use for information is when you need to check that you have done something correctly. Here are some examples to think about.

- Your tutor asks you to carry out a maintenance procedure on a piece of equipment. You need a maintenance schedule and a sign-off document to prove that the task has been carried out correctly.
- You carry out an experiment in the science laboratory and process the results. Perhaps you measured the softening temperature of a polymer or found the surface hardness of a metal. How do you know if your answers are correct? You could ask your tutor, but it's more than likely the tutor will suggest you look them up in a reference source.

- You are in the workshop machining a component on a milling machine. The finished dimensions and accuracies are specified in a drawing. You need to check that your work is correct and get it signed off.
- You are building and testing an electronic circuit. You are given circuit and PCB layout diagrams, together with a test schedule and inspection report pro forma. Once built, you must check the validity of your own work by completing the **test report**.

## Key terms

**Test report** a report of a performance test conducted on a product to see if it conforms to its specification. If it does, then the product can be signed off as fit for purpose.

## Functional skills

Using a variety of information sources to solve an engineering task will help you develop your skills in ICT.

## PLTS

If you use several different sources to find the same piece of information, it will be necessary to make a judgement on which one to accept. This will help you analyse and evaluate information, judging its relevance and value.

## Assessment activity 2.4

P6 M2

BTEC

PSL Ltd manufactures packaging machines and you have just moved into the design office. Before starting on the detail design of a new machine you need to source a variety of information so that you can carry out design calculations and costings. This is the information required:

- tensile strength of mild steel
- maximum service temperature of polypropylene
- the contact details of a company that sells double-acting pneumatic cylinders
- a supplier part number for a 5 kW, 240 V electric motor
- the specification of a limit switch that can be used in the safety interlock circuit of a packaging machine
- health and safety data about noise levels for packaging machinery
- the price of 300 mm wide vacuum packing film
- the cost of vee belts that will handle 5 kW of power
- the dimensions of a deep groove ball bearing to fit a 12 mm shaft
- a manufacturer's order code and price for a bulk pack of 47 kΩ resistors
- a supplier part number for a sensor that will monitor the movement of cartons through a machine
- the limits of size on a 15 mm shaft for an H8F7 fit
- a COSHH data sheet for hydraulic fluid.

Obtain the required information, and present both the data and the source of the information. You might find it useful to set this out in a table.

You must use a mix of computer-based *and* non-computer-based sources to find the required information. You should provide proof of your sources in the form of screen shots and photocopies of pages taken from manuals. These should be annotated to show the information you have identified and used. Be selective in how much evidence you present.

### Grading tip

This activity will provide evidence for **P6**. To develop this work to achieve **M2**, you will need to present copies of all materials accessed (both computer-based and non-computer-based), suitably reviewed and annotated in order to explain their value (or not) and why specific information has been used or rejected. If you have looked through lots of web pages to get to specific information, explain your methodology.

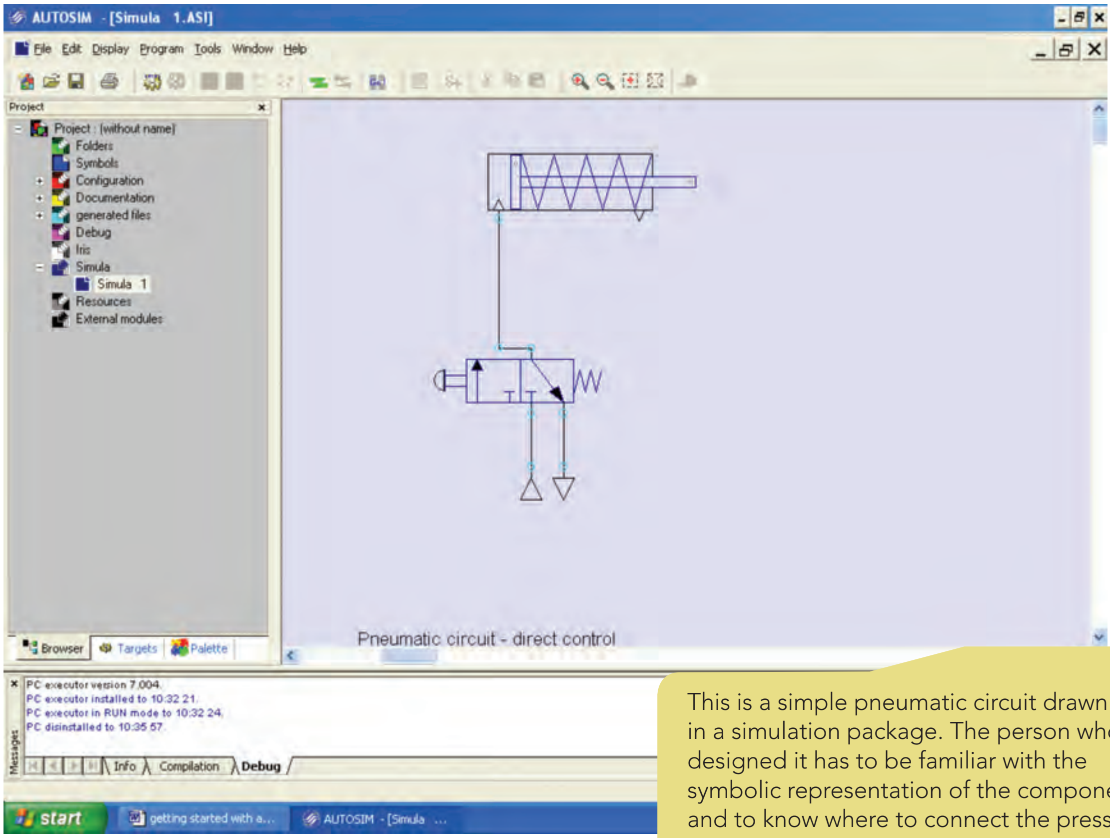
# 2.4 Be able to use information and communication technology (ICT) to present information in engineering settings

Getting accurate information to the right person at the correct time is crucial if an engineering business is to survive in the global marketplace. To maintain synergy between the various departments, the flow and control of information must be carefully structured when using ICT systems. All staff within an organisation will at some time be exposed to the use of software packages and hardware devices when communicating information. A business will have systems in place to protect its internal data and to prevent people being overloaded with unnecessary information.

The key consideration when setting up and using an ICT system is that it should complement the efficient running of a business. There are many occasions when writing on a piece of paper is a more efficient method of communication than using ICT, such as when noting down a phone message on a pad. Some people argue that if all data is entered into a computer system, nothing will be lost – this may be true, but the problem sometimes is finding where the data is stored on the system.

## 2.4.1 Software packages

There is a huge range of software packages in current use, but probably the most well-known is the Microsoft Office suite. It is popular because the programs in the suite are compatible, making it very easy to move data and files between applications. You will already be very familiar with many applications used regularly in business life, such as those which allow you to prepare documents, create spreadsheets, design presentations, set up databases, and send and receive emails. At an entry level, Office is very easy to use and most of the commands are intuitive in the way that they work.




This is a simple pneumatic circuit drawn in a simulation package. The person who designed it has to be familiar with the symbolic representation of the components and to know where to connect the pressure lines.

There is a commonly held view in business that, in terms of functionality and price, Microsoft Office is a powerful package.

The other types of software that engineers use, such as simulation and graphics packages, tend to be relatively expensive because of their specialist nature. It is more difficult to teach yourself how to use these packages, and people using them for the first time require special training. The great thing about a simulation package is that it allows you to try out a design or process before committing to spending money on hardware or machining materials.

Computer-aided drawing (CAD) packages now feature in most engineering design departments and, in many cases, they are linked to manufacturing software that generates instructions for machine tools. Running a 3D simulation before actually cutting metal is a very cost-effective way of debugging a manufacturing process because it only involves paying for a person's time.

Simulation software is used when designing electronic and fluid power circuits, the layout of machinery in a manufacturing plant and processing systems. The trap that some people fall into is thinking that no subject knowledge is needed by the person using the software. In its simplest form simulation software just allows you to set up 'what if' scenarios, such as 'what happens to the performance of a circuit if I change this electronic component for a different one?'

Communication software and systems now allow people to work in ways which were not possible ten years ago. For example, a sales engineer might have a meeting with a customer and then go to her car for a technical discussion with someone back at base. Using a laptop computer and mobile internet connection, the engineer could send files, talk or video conference and agree delivery dates and prices. The engineer then goes back to the customer, and completes the deal and sends confirmation emails. Job done, the engineer drives on to the next customer, checking where to go by 'talking' to the car's speech recognition satellite navigation system.

## 2.4.2 Hardware devices

The first use of the term hardware was in the early days of computing when it applied to the actual computer. It meant a piece of electronic equipment, which had built-in input, processing, storage and output systems. Now the term is used in a much wider context and covers any form of device that contains 'hard' components. Products which connect to a computer, such as a mouse, are called peripherals. You will be familiar with many types of hardware device. Indeed you may have used many of the following devices:

- desktop PC
- laptop (with Wi-Fi)
- modem/router
- USB pen drive
- external hard drive
- process controller
- scanner
- digital camera
- optical recognition device
- speech recognition device
- printer
- plotter
- interactive whiteboard.

Personal computers (PC) are now ubiquitous items in most homes and businesses, but this is not the end of the story. Most products or systems that need to be controlled will include a computer of some form. It may not be called a computer; microprocessor is the name you may be familiar with. For example, the engine management system in a car is effectively a computer – it inputs data from **sensors**, processes this data, makes decisions and then carries out adjustments to parameters such as the amount of fuel injected into the cylinders. All of this happens in microseconds.

The control of plant and manufacturing processes also requires the use of complex computer systems. An individual piece of equipment would be controlled by a programmable logic controller (PLC), with performance data sent back over a network to a master computer which monitors the system. This control computer might be many miles away and accessed remotely by a technician who is on call-out duty.

### Key terms

**Sensor** a device which receives and responds to a signal/input.

## 2.4.3 Present information

Although there are many definitions of 'engineering', they all come down to one simple phrase: engineering is about turning ideas into reality through the appliance of knowledge, science, resources and effort.

People continuously come up with ideas for making money, saving the planet, making life easier etc. It would be interesting to know how many ideas are generated throughout the world in a year. No one can put a figure on it. What we do know is that only a relatively small number actually make it to market.

To bring a product to market involves presenting information which will:

- convince investors to back the project
- motivate people working on the project
- allow the design of the product to be finalised
- set out how the product is to be made and tested
- drive forward marketing initiatives
- encourage customers to buy the product.

What we are really saying here is that engineers must be good at preparing and communicating information if they are to succeed in business. How is the information communicated? As you will have seen by working through this unit, it is by:

- writing – letters, reports, emails, memos
- tabulating – technical specifications, test data
- graphics – graphs, charts, images, diagrams
- speaking – telephone, face to face, presentations.

Some of these methods don't require the use of ICT, but most are much easier to carry out if you do.

### Activity: Visual presentation

Working with a colleague, select an engineering topic that interests you both. Then:

- plan a five-minute presentation about the topic
- put together a short set of PowerPoint slides, including text and images, with one slide containing a video clip and at least one slide with a pasted-in (pie, bar or scatter) chart
- set up an ICT system comprising a computer, multimedia projector, interactive whiteboard and printer
- run the presentation, pause at the chart, have a brief discussion about its content and mark-up some comments on the whiteboard using an electronic pen
- investigate how to save and print the marked-up slide.

### Activity: Presenting information in writing

Some students from a local college are going to visit your company. Their tutorr wants them to discover that there is more to engineering than just cutting metal, assembling parts or soldering components. You and a colleague work in the manufacturing department, and you have been asked by your manager to help out by preparing a document to show the students the writing skills required by engineers.

Working with your colleague, put together a 200-word technical mini-report. This should be word processed and the report should include:

- original text
- an image from a digital camera and an image sourced from the internet
- an imported spreadsheet and chart
- text, cut and pasted from a different report
- a table with some shaded cells
- bullet points
- page numbers
- a title page and company logo.

Print off a hard copy of the report and save it on a computer in a folder, which should be part of a properly structured electronic filing system.

Suppose the teacher likes what you have shown and asks if you can email a copy of the report to the head of technology at the college. Now:

- write a covering letter as a formal email
- attach the report to the email and send it to a colleague
- check that it arrives, and that it can be downloaded and saved.

## Assessment activity 2.5

P7 M3 D2

BTEC

Put together a portfolio of evidence which proves that during the time spent studying this unit (or other units on your course) you:

- correctly selected and used IT hardware, relevant input/output devices and software packages in an engineering situation
- used a software package to word process a document
- used a software package to produce a 2D drawing
- handled and processed data using software packages
- used a simulation software package
- communicated using e-systems
- used a computer system to present a technical report in written, numerical and graphical forms
- prepared and made a visual presentation using a software package and multimedia facility.

If you do this you will meet the requirements for P7.

To achieve M3 you should select one of the software packages that you have used when preparing and presenting information, then write a 250-word evaluation of its effectiveness as a tool for the preparation and presentation of information.

To achieve D2 you must write a 500-word document, relating to your project, which evaluates your use of an ICT presentation method and identifies an alternative approach.

### Grading tips

Much of the evidence needed for **P7** you will have from previous assessment activities, and it should be just a case of pulling it all together. This is very much a tracking exercise, and you should discuss with your tutor whether it is necessary to print everything off again. What is important to realise is that when your evidence is verified, you must have a good tracking system in place so that evidence can be easily found.

Take care with the report for **M3**. You should reflect on your work and evaluate the effectiveness of the software and associated tools (such as font size, alignment etc) to support the preparation and presentation of your information. You do not report on how well you performed in terms of the quality of your drawing, writing or speaking.

For **D2**, you are evaluating your use of an ICT presentation method and identifying an alternative approach. This should be about the method of presentation and not the method of communication. You could, for example, base your evaluation on the summary leaflet you produced for assessment activity 2.3, which you probably produced in Microsoft Word. Would it have been easier and better produced if you had used desktop publishing (DTP) software such Adobe InDesign or presentation software such as PowerPoint? You could rework parts of the leaflet to support your written evaluation.

## PLTS

This last assessment activity can only be successful if you plan it well and organise your time. As you are pulling together information and equipment resources you may well be multitasking.

## Functional skills

Selecting and evaluating the use of ICT software packages and hardware devices to present engineering information will help develop your skills in ICT.

WorkSpace

# David Short

## Design engineer

I am the team leader for a small group of people who work on the design and development of new products. My company produces portable hydraulic power packs for use on construction sites in the UK and Europe. A power pack is constructed from three main parts: a four-stroke petrol engine, a hydraulic pump, and a sump, filtration and valve control system.

The projects I work on usually start with me picking up an email from my technical director worded something like this: *Dave, To expand the product range, marketing want us to design a pack which has a 112 volt ac generator fitted so that it can be used to power electric hand tools. An electrical control unit containing a voltage regulator and overload circuit breaker will need to be fitted.*

I will then meet up with the chief designer to discuss ideas and firm up some design proposals with my team. I will arrange to meet with the manufacturing department and then get back to the technical director with finalised design proposals, including estimates of manufacturing costs. I will arrange a design review meeting at which we select the proposal to be taken forward for production.

**How long does this take?**

This first phase of the project usually takes a couple of weeks. My team have different specialist knowledge and we work with a CAD system so that it is very easy to pass ideas around.

The design review meeting is a major event and it has to be well organised, because as well as the engineers there will be people from the marketing, sales, logistics, finance and legal departments. I find these types of meeting quite challenging, but it's worth the effort when you see the new product rolling off the production line and being despatched.

### Think about it!

1. What information will Dave take to the review meeting?
2. How will he present the design proposals?
3. Who will chair the meeting?
4. What type of graphics will Dave show the non-engineers?
5. Why do think Dave finds review meetings challenging?
6. Dave's job sounds interesting. Why do you think this is?

# Just checking

1 Identify the three categories of information that might be presented in an engineering sketch, circuit diagram or network diagram.
2 Explain what is meant by 2D and 3D drawing techniques.
3 Why do engineers use British and International standards?
4 If you needed to find a particular standard, how would you start your search?
5 Why is it important to keep good notes when recording the progress of a project?
6 Explain how to plan the layout of a technical report.
7 What are 'active listening skills', and how can you improve them?
8 What is a reference source?
9 At the end of a report or document you may find a bibliography. What is its function?
10 Most electronic information sources contain vast amounts of data. Explain the steps you should take to ensure an information search is efficient.
11 How can you be sure that an information source is accurate and up to date?
12 You need to send a personalised letter with the same main content to 50 customers. Explain how you will do this using Microsoft Office.
13 You have to deliver a 10-minute presentation on a technical subject to a small group. Explain the ICT equipment you will need to prepare and deliver your talk.



# Assignment tips

- You don't have to be a brilliant or super confident speaker to be an effective communicator. Practice helps, and most of the activities in this unit are designed to be carried out in pairs or small groups so that all the time you are communicating.
- The evidence you need to produce for this unit will not always be in a written form. Make sure that your tutor obtains observation records or witness statements for any assessment activity which requires non-written evidence. This could be when you are speaking or presenting to an audience, amending a document on screen, or doing something in real time which needs reporting on.
- Ensure that all drawings and diagrams are produced to appropriate standards. Drawing standards can be large documents, and it can sometimes be difficult to find what you need. Ask your tutor for a cut-down printed version specific to your needs.
- Communication skills are generic, and much of what you have covered in this unit can be applied throughout your BTEC National programme. In particular, this unit has strong links with three other units and some of the evidence you have collected could be used to help demonstrate that you have met some of the grading criteria for Unit 3: Engineering Project (P6, P9 and P10), Unit 8: Engineering Design (P6) and Unit 16: Engineering Drawing for Technicians (P1, P3 and P6).